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Article

Consumer response to fuel economy in the face of global fuel crises

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Abstract: One crucial determinant of the overall cost of national fuel efficiency rules is how consumers evaluate trade-offs between the initial cost of vehicles with better fuel economy and the anticipated savings in fuel expenses. Vehicle selection modeling is a useful tool for evaluating variations in customer preferences when it comes to purchasing vehicles. Additionally, it explores the impact of these changes on consumer surplus and compliance costs. The study employs a particular selection test under comparison test conditions to investigate its impact on the visual representation of fuel economy data. The fuel economy data is displayed distinctly for each of the six factors: average monetary savings/spending over four years compared to a car in the same class, miles per gallon, fuel costs over six years, yearly fuel prices, the complete government-mandated fuel efficiency label, and the total fuel cost throughout the lifetime of the vehicle. A nationally representative sample of 950 prospective car purchasers in Ghana was randomly allocated to a single situation throughout the country. The study determined that the data presented had a direct impact on how consumers assess fuel efficiency. When comparing other criteria such as annual fuel cost, five-year fuel cost, and spending/saving comparisons, the study found a significantly higher willingness to pay value for participating in the scenario that included fuel economy labels. The value was adjusted based on participant statistics. Participants of advanced age and those who anticipated a somewhat reduced expenditure for their forthcoming automobile attributed greater significance to fuel efficiency. This research investigates potential reasons for the disparities between consumer willingness to pay for fuel efficiency and the offerings of automakers, despite the limited available data to assess the relative importance of these various theories.

Keywords: fuel economy; consumer response; purchase price; participant statistics; Ghanaian economy

1. Introduction

Global transport energy consumption is expanding at a median of 1.1% each year. Global petroleum and other liquid fuel use increased 63% between 2009 and 2035, mostly in the transport sector. Africa's transport energy demand will rise 0.9% yearly from 4 quadrillion Btu in 2009 to 5 in 2035. Many policymakers now consider sustainability as the key to economic progress in any country, developed or emerging. Energy is used to transport people and things by pipeline, road, air, water, and train. Transport infrastructure boosts trade, economic competitiveness, and quality of life in a globalized society. Trade and economic activity drive freight handling demand. More complicated factors like travel patterns, land use patterns, urbanization, macroeconomics, and fuel markets affect passenger transport [1]. On1 April 2010, the EPA and Transportation Department issued regulations to reduce greenhouse gas (GHG) vehicle emissions and tighten the Corporate Average Fuel Economy. Fuel economy in consumer car purchasing was a prominent analytical concern in the criteria assessment. Do consumers consider fuel savings of fuel-efficient vehicles while buying? Will fuel efficiency demand help or hurt consumers and manufacturers? They will be interested in this problem when other countries contemplate fuel economy and GHG tailpipe regulations. According to the International Council for Clean Transport (ICCT), some governments are considering tighter automotive GHG restrictions. Coal, oil, petroleum, and natural gas are fossil fuels. A key step in lowering CO_2 emissions is eliminating fossil fuel subsidies. **Figure 1** shows fuel kinds and examples. Different nations offer fuel subsidies. They aim to boost welfare, lower gas prices, and improve government-citizen relations. Easy to install, yet expensive and difficult to maintain or remove, they typically fail to help the most vulnerable. Ghana is a sub-Saharan African nation of 30.8 million that relies on fossil fuels for energy. Since 2000, petroleum has supplied 80% of Ghana's energy without biomass. Ghana is a small West African gas and oil producer that exports crude oil. Natural gas produced there powers the nation's power plants. Ghana's energy mix relies on biomass and wood fuels, however, fossil fuel consumption has steadily reduced biofuel use. At 5.83 percent per year, fossil fuel energy usage rose from 18.8% of total energy consumption in 1995 to 52.5 percent in 2014. Close to 87.5 percent by 2020. National energy statistics show biomass utilization dropped from 49% of the primary energy supply in 2010 to 40% in 2018 [2]. It kills 9 million people annually, 85% in developing nations [3]. Transporting 24% of fuel combustion's direct CO_2 emissions is the fastest-growing global fossil fuel emission [4].

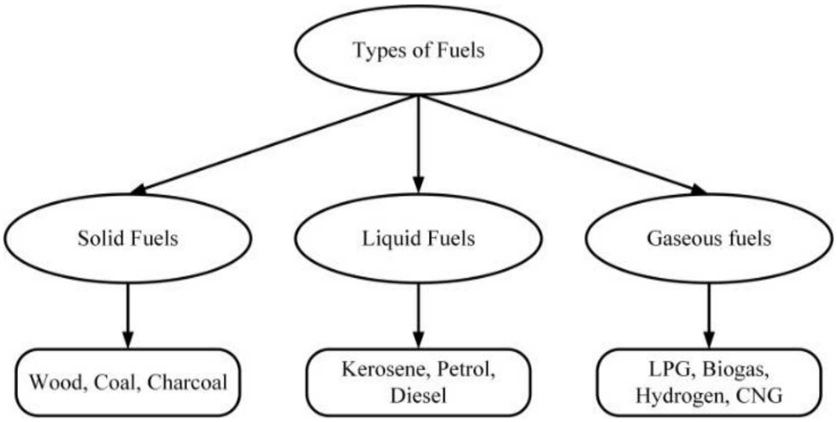

Figure 1. Various types of fuel.

The economic activity of any country is highly dependent on energy. Similarly, transportation that facilitates both passenger and freight movement is important for the expansion of every economy. Crude oil is one of the most widely used energy sources[5]. Once crude oil is extracted from the ground, the refinery converts it into usable materials, often into non-renewable fuels for transportation. According to Ghana's Strategy National Energy Policy (SNEP), the transportation sector uses 99.7 percent of the country's petrol and 85 percent of its diesel. Approximately 2.5 million road transport vehicles are in use in Ghana, most of the passenger vehicles. As the main source of combustion in Ghana, PMS or petrol is the mainstay of vehicle use. Between 1999 and 2012 about 11 billion and 15 billion liters of PMS and petrol were used. With the use of numerous economic measurements to analyze the demand for automobile gasoline, the investigation into automotive fuel consumption has gained much interest over the past 40 years. The biggest concern is analyzing the consequences of fuel use as a result of the risks to fuel energy conservation [6]. **Figure 2** represents the various reasons for increasing the fuel price.

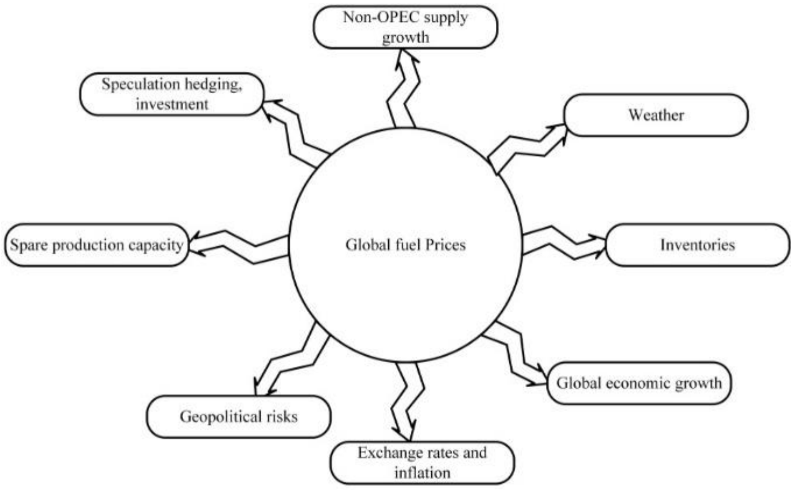

Figure 2. Various reasons for fuel prices to increase continuously.

Privately owned automobiles have expanded in Ghana over the past few decades, where the gasoline demand is increasing almost daily. Ghana and the rest of the world have focused on factors that affect how much petrol is used for transportation-related activities. In recent years, the demand for petroleum energy around the world has grown significantly, and its solution is urgently needed [7]. Although the dependence level varies depending on the mode, there is a clear correlation between transport and energy. Quick and energy-intensive methods can send passengers more valuable cargo [8]. In addition, the transport sector was hit hard by fuel shortages and a lack of foreign exchange to buy crude oil (oil and gas), resulting in disruptions to business routes for drivers and homes standing in regular queues. The movement of goods and services inside and outside Ghana was also hampered due to high transportation costs which lead to high food costs. Despite the country's oil production, fuel costs continue to rise, which is bad for the average Canaanite. While Ghana produces oil, the price of gasoline rose by 7% in 2014. For decades, there have been numerous reports of adverse reactions to the rising prices of petroleum products. According to a 2011 report by the Ghana News Agency, almost a month after the current petrol price hike, passengers and drivers are still arguing about fares in the metropolitan area of Kumasi [9].

According to the United Nations Environment Program, 40 percent of older light cars are imported from Africa and 70 percent from developing countries [10]. In addition, most countries that import or build these vehicles in Africa do not have emission rules governing the type of emission equipment to be placed on these vehicles. In addition, emissions analysis is not required by the annual vehicle inspection system. Therefore, proper maintenance of vehicles to guarantee the effective operation of emission-related technology is not a major concern even when they are available. The primary objective of every government is to develop the economy of the country to improve the living standards of its people. The economic and social development of a country is greatly affected by mass transportation. The transportation sector in Ghana uses a significant amount of fuel. The average annual demand for crude oil, according to currently available data, is 5 to 7 percent, and this demand is likely to increase as the number of cars on the road continues to expand across the country. The country is thus concerned about efforts to reduce traffic congestion and fuel consumption rates. Ghana spent $ 276 million on petrol subsidies in 2011, or about 450 million Ghana cedis. This is 45 million Ghana cedis every month. **Figure 3** represents the analytical study of fuel prices in Ghana.

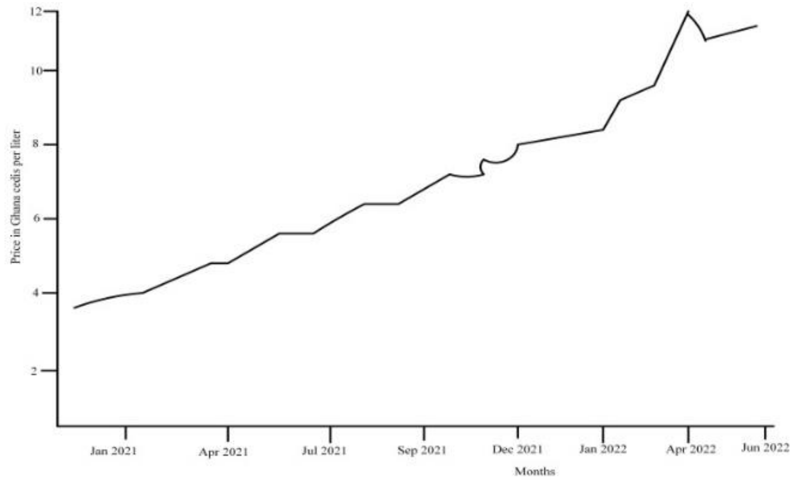

Figure 3. Analyzing the fuel price in Ghana.

In addition to transportation, energy plays a significant role in a country's economic development. The transport, infrastructural, agricultural, and industrial sectors are crucial for all aspects of national growth. It is imperative to employ it sustainably due to its finite and non-renewable nature. There is a definite correlation between transportation and energy in national growth, however, the strength of this correlation depends on the type of transportation and the demand for the sector [11]. The majority of the global energy consumption resulting from human activities is currently attributed to transportation. In affluent nations, the transportation sector constitutes approximately 20 to 25 percent of the overall energy use. The economic analysis of Ghana's energy industry reveals that the transport sector accounts for 23.9% of Ghana's total energy consumption [12]. Ghana's transportation industry relies predominantly on fossil fuels, particularly petroleum products, as its main sources of energy. The energy consumption will vary depending on the chosen mode of transportation. In developing nations, passenger transportation accounts for approximately 60-70% of the overall land usage, which averages at 85%. Private automobiles are the predominant mode of transportation for passengers in these countries. To mitigate traffic congestion and alleviate excessive fuel consumption rates, it is most effective to enhance the utilization of public transportation [13]. The underestimation of mass transportation in Ghana, particularly in urban areas, as a method to enhance energy efficiency, is evident. Furthermore, the nation's crude oil consumption has been augmented by the ongoing surge in automobile ownership, leading to escalated import expenditures for crude oil. The substantial outlay on oil imports exerts significant strain on yearly budgets and leads to substantial trade imbalances. Manual gearbox vehicles provide a fuel economy advantage of around 10% compared to their automatic equivalents and offer enhanced control in demanding driving situations. Moreover, manual transmission vehicles exhibit lower costs, necessitate fewer frequent repairs and maintenance, and provide superior fuel efficiency for urban driving compared to automatic transmission autos, albeit contingent on driving habits. Operating a manual gearbox car provides drivers with more control and reduced distractions [14].

Evaluating the impact of factors such as vehicle quantity, fleet composition, vehicle specifications, vehicle performance, fuel quality and type, transportation methods, driving behavior, road conditions, maintenance and inspection practices, and wear and tear on naval fuel efficiency is a complex task [15]. Prior research has emphasized the significance of assessing the fuel efficiency of naval vehicles, especially those that have traveled more than 500,000 km [16]. Even though modern engines can currently endure distances over 800,000 km without needing repairs, the environmental systems in the US and Europe still consider the deterioration rates of automobiles with lower mileage [17]. The expense of research and the limited availability of resources further complicate the task of assessing fuel efficiency in practical applications. These exceptionally long distances are characteristic of car fleets throughout Africa. When this data is available, it can be utilized to compute present levels of greenhouse gas emissions, establish initial emissions levels, and investigate potential emissions scenarios for evolving vehicle fleets. Given the absence of emissions reduction policies in Africa, it is crucial to have a comprehensive awareness of the current emissions to develop and uphold such policies [18].

The commercialization of fuel has an impact on both the local and macro economies of every country, including Ghana. Fuel price adjustment refers to the periodic variation in the price of fuel-related products due to changes in worldwide fuel prices. Fluctuations in fuel costs persistently influence the pricing of various commodities globally and have repercussions on the production, revenue, and profitability of numerous companies. The volatility of petrol prices has a significant impact on small and medium firms. One reason for this is that small and medium firms play a crucial role in combating poverty [19]. This study examines the issue by quantifying how customers judge fuel economy using multiple indicators and how this evaluation is connected to consumer attributes. The study is unique in that it employs a test, and behavioral science method, and involves participants who are randomly assigned to different settings as part of a specific selection experiment. The selection test allows participants to evaluate commercial transactions based on fuel economy and other vehicle attributes. While the study suggests that changes in the way fuel economy data is presented could influence how consumers evaluate it, it is important to note that this study is the sole one that uses this particular method to examine this phenomenon.

2. Literature review

2.1. Understanding household energy consumption in Ghana

The study utilized data from GLSS 7, as well as the Quadratic Almost Ideal Demand System (QUAIDS) prototype and the Multivariate Profit Framework, to examine the patterns of home energy consumption and the corresponding cost responses for household energy in Ghana. The research primarily investigates the fuels of electricity, kerosene, LPG, firewood, coal, and other miscellaneous fuels (FCO).

The results indicate that the price, income, and social demographic variables exert a substantial influence on Ghana's demand for all domestic energy fuels. While FCO and kerosene fuels exhibit poor performance, there is a strong demand for LPG fuels and electricity in households, with values over 1. Despite the inherent volatility and negativity of all energy fuels, the price of current fuels such as LPG remains resilient. Both gasoline and electricity exhibit a strong sensitivity to rises in price. When assessing the cross-price elasticity of different fuels, it is important to take into account their cultural, socio-economic, and specific utilization. The analysis revealed that, despite the negative requirement for all energy fuels and the flexibility of pricing, the own price flexibility (LGP and ECG) for modern fossil fuels experienced a slight drop after adjusting for the impact of zero energy expenditure. This work has significant implications for policies aimed at ensuring the broad availability of efficient and clean domestic energy fuels for consumption, as well as policies aimed at reducing the cost of residential energy fuels.

Research is scarce on the determinants of household energy consumption in Africa, particularly in Ghana. This study aims to distinguish between "clean" fuel and "dirty" fuel to identify the factors that influence the usage of domestic fuel by families. The demographic and health survey results encompassed a sample of 11,835 households in Ghana. To ascertain whether a household utilizes "clean fuel" or "dirty fuel", the study employed binary methodologies such as binary logistics and binary profit, taking into account socioeconomic characteristics and spatial variance (regional location). The results indicate that socioeconomic characteristics have an impact on the energy consumption of households, with rural households facing more challenges in adopting clean fuel compared to urban households. Moreover, households headed by men utilize cleaner fuels compared to those headed by women. With the growing affluence of families, an increasing number of homes are choosing cleaner fuels for cooking. Furthermore, the majority of households persist in utilizing solid fuels, such as charcoal and firewood, as their primary energy sources for cooking. The utilization of these contaminating fuels might have a detrimental impact on the health of households due to internal pollution. The research recommends the formulation of policies aimed at facilitating the use of more efficient and environmentally friendly energy sources for residential use [21].

Ghana's endeavors to attain a middle-income status align with the growing need for electricity and other forms of energy. Studies dependent on fossil fuels indicate that an increase in energy or electricity usage may result in the release of greenhouse gases. Ghana's socio-economic systems, such as agriculture, forestry, and energy production, are presently exhibiting indications of the impacts of climate change. Hence, it is imperative to advance and execute a low-carbon, enduring energy production strategy that fulfills the electrical requirements of the intended primary economic goals. This work employed a quantitative modeling and simulation strategy to analyze the impact of fuel conversion on the energy production system and the ecosystem. The analysis was conducted utilizing the energy source approach and a generalized environmental effects analysis tool. To effectively decrease CO_2 emissions in Ghana's energy sector, it is crucial to integrate low carbon emissions conversion technologies like as nuclear and renewable energy. Incorporating climate-friendly energy sources into the electricity industry is essential for achieving sustainable, dependable, and environmentally friendly power generation. To meet its international climate change commitments, Ghana must rely on fossil fuels for electricity generation. However, it is advisable for the country to also include zero-emission sources in its energy mix [22].

2.2. Environmental hazards in energy consumption

West African nations encounter substantial environmental hazards that diminish their overall quality of life. It is estimated that emissions-related diseases cause the death of around seven million individuals annually in the region. Minimizing emissions pollution has the potential to save lives and mitigate global climate change, as different emissions resulting from climate degradation also impact human health. The study examined multiple environmental elements that may positively impact the quality of life in West African Anglophone countries. The study's period was from 1990 to 2018, utilizing the group size regression method. The findings unveiled carbon dioxide (CO_2) emissions originating from gaseous fuels, liquid fuels, residential buildings, businesses, public utilities, and solid fuel usage. The quality of living in Anglophone countries in West Africa could be affected by transportation. Healthcare expenditure, mortality rate, and fertility rate are supplementary variables that influence the overall standard of living. Hence, policymakers must implement measures aimed at mitigating emissions, including but not limited to energy conservation strategies, across many sectors such as liquid and gaseous fuel use, residential buildings, business and public services, solid fuel usage, and transportation. Furthermore, it is imperative to provide enough financial support to the healthcare sector through higher healthcare expenditures. This would enhance health outcomes and contribute to the overall quality of life at a national level [23].

In less developed nations, coal and wood are the primary energy sources. In Ghana, the primary utilization of savannahs and woodlands is for the gathering of charcoal and firewood. The exponential increase in population exerts additional strain on forests and woods, hence fostering excessive utilization and devastation. The study employed a combination of research methods to investigate the utilization of household biomass in the process of deforestation within the Eastern Municipality of Sissala, Ghana. Data was collected from a diverse range of community members in the six rural and urban districts through methods such as desk assessments, home surveys, focus groups, and interviews with key informants. Research indicates that the primary source of energy for the majority of households in the study area is firewood, predominantly obtained from farms, forests, and open savannah woodlands. The study moreover shows that the utilization of firewood exerts a detrimental influence on both the environment and the well-being of the populace, particularly ladies. This is due to the higher propensity of women to inhale the smoke emitted during culinary activities compared to men. The study also demonstrates that LPG is the prevailing alternative energy option for residential use, although its exorbitant price poses a significant obstacle to its widespread adoption. The analysis indicates that ongoing firewood gathering poses a substantial risk to environmental sustainability. The report recommended that the Forestry Commission of the Ministry of Agriculture should undertake educational and awareness efforts to educate families about the sustainable extraction of fuel trees. The research conducted by [24] highlights the fact that individuals have various preferences when it comes to transportation options. These preferences are impacted by a multitude of criteria, such as cost, convenience, safety, and accessibility. Furthermore, the findings of the study indicate that the socio-economic characteristics of respondents, such as age, income, automobile ownership status, and work status, have a major impact in determining the preferences of individuals for various modes of transportation over others.

2.3. Impact of household energy and challenges rural energy access

Energy is a crucial driver of economic progress in emerging nations, playing a critical role in education, industrial production, and the health sector. An eminent challenge confronting policymakers in developing nations, such as Ghana, is the augmentation of energy accessibility in rural regions. Hydrohead difficulties such as power outages, energy availability, access to capital, and market access are challenges that medium and small firms (SMEs) in underdeveloped nations face. Contrary to national trends of increasing energy efficiency, rural areas face a distinct situation due to limited access compared to metropolitan areas. This is primarily because rural areas mainly depend on biological and other genetic energy sources. This study is structured around three distinct periods. The initial phase employs the product production dematerialization approach to evaluate the efficiency of electricity and fossil fuel utilization. The second phase will involve an examination of the energy efficiency practices employed by medium and small firms. The third stage of the study examines the relationship between productivity, energy efficiency, and carbon emissions using a commonly used unconstrained framework known as GUM. The study's primary findings indicate that energy utilization is inefficient and that energy consumption among small and medium-sized enterprises (SMEs) is decreasing, except during blackouts. Additionally, the study highlights that productivity plays a crucial role in achieving energy efficiency. To summarize, domestic research indicates that the reduction in energy consumption is not attributable to enhanced productivity resulting from the use of more energy-efficient technologies. Contrary to expectations, an analysis of the rural energy scenario reveals that blackouts lead to unintentional reductions in energy supply. Moreover, research has demonstrated that rural small and medium-sized enterprises (SMEs) employ minimal energy-efficient practices. The recommendation proposes enhancing public consciousness regarding energy efficiency and transitioning from outdated appliances to newer ones as a means of conserving energy [25].

The affordability of sustainable and reasonably priced food goods is crucial for ensuring food security. Increased food expenses reduce a family's inclination to allocate funds toward other essential aspects of life, such as education and healthcare. In 2007–2008, there was an unforeseen surge in the prices of fuel (petroleum goods) and food worldwide, which garnered the interest of scholars and international leaders. Ghana's food and agriculture policies have diverged due to the influence of increasing fuel costs on the pricing of maize. The country's primary maize markets include a price transfer system that exacerbates this impact. This study investigates the dynamics, extent, and responses to fluctuations in gasoline prices in various maize markets in Ghana. To accomplish this, data from the Ministry of Food and Agriculture (MOFA) was gathered regarding the monthly prices of maize from January 2000 to December 2015. Furthermore, ACEP furnished monthly data regarding gas expenses during the corresponding timeframe. The employed methodologies encompass trend analysis, integration, threshold auto-correction (TAR), and impulse response function analysis. The price of maize in all four markets analyzed consistently followed the same trend as the price of gasoline over several years and months. Prices were incorporated into all marketplaces and they elicited significant constraints. Furthermore, the price of corn had a rapid and significant surge across all markets during the examined years coinciding with the rise in gas costs. The study revealed that this effect persists and does not result in a negligible decrease in maize prices. Hence, it is prudent to consider the impact of regulations on gasoline prices on the cost of maize. [26] Highlight a discrepancy between the expectations and perceptions of passengers when it comes to the qualitative qualities of public bus services. The study highlights that cost and availability are crucial elements that have a major impact on commuters' subjective pleasure. Additionally, it recognizes that availability, security, and dependability are crucial variables linked to the expected levels of satisfaction among commuters. The research suggests that the expectation model is more effective in explaining passengers' happiness and usage of Public Bus Transport (PBT) than the perception model. This observation emphasizes the significance of comprehending the expectations of commuters in influencing their satisfaction and use behaviors, therefore offering significant implications for improving the quality and efficacy of public bus services.

Amidst the worldwide fuel crises, comprehending how consumers react to fuel efficiency becomes progressively vital. This literature review explores important subtopics related to this field of study, specifically the influence of household energy and difficulties in accessing energy in rural areas, fuel efficiency during global fuel shortages, sustainability of transportation systems, the effects of government policies and regulations, and initiatives to increase consumer awareness and education. How energy is consumed inside households has a substantial impact on fuel efficiency and how individuals respond to fuel shortages. In remote rural regions, where there is limited availability of modern energy sources, households frequently depend on traditional biomass fuels like firewood and charcoal for cooking and heating. This dependence presents difficulties in terms of long-term viability, deterioration of the ecosystem, and potential health hazards [27]. Furthermore, the unequal distribution of energy access worsens socioeconomic inequities, disproportionately impacting disadvantaged communities [28] To tackle the difficulties in providing energy access to rural areas, it is necessary to adopt comprehensive strategies that incorporate renewable energy solutions, community empowerment, and legislative assistance [29]. Amidst worldwide fuel problems, buyers continue to prioritize fuel efficiency as a crucial factor. The motivation to improve vehicle economy and encourage the use of alternative fuels stems from increasing fuel costs, disruptions in supply, and growing environmental concerns [30]. Consumers react by actively searching for fuel-efficient automobiles, embracing eco-driving practices, and investigating alternate forms of transportation [31]. Nevertheless, obstacles such as financial limitations, inadequate infrastructure, and resistance to change hinder the general use of fuel-efficient technology [32]. To overcome these issues, policymakers, industry stakeholders, and consumers must work together in a coordinated manner.

2.4. Sustainability of transportation systems and impact of government policies

To achieve sustainability in transportation systems, it is necessary to incorporate economic, environmental, and social factors into the planning and decision-making processes. Sustainable transportation seeks to reduce adverse effects on the environment, improve accessibility and fairness, and foster economic efficiency [33]. This involves encouraging a transition towards using public transportation, walking, and cycling, as well as progressing in the development of fuel-efficient technology and alternative fuels [34]. Sustainable transportation efforts involve strategies such as land use planning, infrastructure investments, and policy interventions that attempt to promote integrated and efficient mobility systems [35]. Government rules and regulations have a crucial influence on how consumers react to fuel efficiency and fuel shortages. Fuel efficiency requirements, pollution restrictions, and taxation policies have an impact on the choices consumers make when purchasing vehicles, as well as on the development of new technologies and the overall dynamics of the market [36]. Moreover, the implementation of rewards for the adoption of renewable energy, investments in public transit, and methods for pricing carbon have a significant influence on the patterns of fuel use and mobility choices [37]. Effective policy measures need a careful combination of economic incentives, environmental goals, and social fairness concerns, while also promoting stakeholder involvement and adherence to the policies [38].

2.5. Consumer awareness and education initiatives

Consumer awareness and education activities play a crucial role in increasing fuel efficiency and fostering sustainable transportation habits. Public outreach initiatives, instructional programs, and information distribution activities aim to educate customers on fuel-efficient driving behaviors, alternative transportation choices, and energy-saving devices [39]. In addition, the progress in technology, such as the development of smartphone applications, online platforms, and interactive tools, has made it easier for consumers to obtain important information and has given them the ability to make well-informed decisions [40]. Developing a sustainable culture necessitates continuous endeavors to enhance consciousness, acquire information, and encourage environmentally friendly attitudes and actions among consumers [41]. To tackle fuel economy in the wake of global fuel crises, it is necessary to adopt comprehensive strategies that consider several factors such as home energy usage, sustainable transportation systems, government interventions, and consumer involvement activities. By comprehending the interaction among these aspects, those with a vested interest may formulate efficient tactics to encourage the use of less fuel, reduce negative effects on the environment, and improve the security and availability of energy.

2.6. Summary

The literature review provides a thorough examination of household energy consumption trends and associated variables in Ghana, utilizing insights from several research and approaches. The review highlights the complex nature of energy dynamics in Ghanaian homes, including topics such as assessing the demand for various energy sources and studying the effects of energy use on deforestation and agricultural prices. The key findings emphasize the impact of price, income, and socio-demographic factors on energy consumption, along with the difficulties and possibilities linked to shifting towards more environmentally friendly energy sources. Furthermore, the research highlights the significance of governmental interventions in fostering sustainable energy habits and reducing environmental concerns. These findings enrich our understanding of energy consumption trends in Ghana and offer useful insights for policymakers seeking to improve energy accessibility, affordability, and sustainability in the country.

3. Methodology

3.1. Establishing a survey

To gain a deeper comprehension of the research inquiries, the study administered a survey to 950 individuals who expressed their intention to purchase or lease the car within the next twelve years. Participants completed three sections of the 20-minute online survey. Participants completed a series of fundamental questionnaires, which included information about their demographic, their current vehicle (make, model, annual mileage, and usage patterns), and their future vehicle preferences (desired make and model, timeline for acquisition, anticipated cost, and preference for leasing or buying a used or new vehicle, as well as intended usage). After completing a selection test aimed at determining their vehicle preferences, participants were given one of six test parameters. Participants are required to choose a maximum of six vehicle attributes from a list of 20 options provided by Consumer Reporting Experts. They must then score these six characteristics, expressing their preferences and indicating what they value in a car. Furthermore, the selection test assesses participants' ability to locate the latest fuel economy data for leasing or purchasing.

3.2. Selection research

In the said selection test, participants were shown six sets of vehicle options, each consisting of three unnamed vehicle selections with systematically different characteristics. These packages are designed according to every participant's expected buying cost and vehicle class for their next vehicle (little SUV, medium SUV, big SUV, little car, medium car, big car, utility vehicle, or microbus). Participants picked a car that they could buy or lease from each pair. In each of the eight vehicle classes, five additional vehicle characteristics in addition to fuel economy were incorporated in the selection test.

- Every participator's self-reported anticipated buying cost served as the basis for one of four levels representing the purchase cost.
- The midway of the accelerators for each class is the center of the accelerated (0–60 mi) presentation, which is one of three stages and is customized for every

participant’s expected vehicle class for an upcoming lease or buying. The selected range is defined as the information provided by the expert in consumer reports, according to which the highest and lowest numbers are 30 percent higher and lower than the midpoint.

For each of the eight vehicle types, fuel economy is described as one of four stages, represented in **Table 1.** Every level is centered on the average fuel economy that is next to the participants’ self-reporting vehicle class. For buying or leasing, the lowest and highest scores in the range are 30 percent higher and lower, respectively, from the middle of that class. Based on the randomness of each participant’s test, the data to be provided about fuel economy changed between six possible scenarios. Fuel economy rating is obtained by the assumption that the vehicle travels 16,000 miles annually and spends 60% of its time in cities and 40% of its time on highways, depending on the EPA’s estimates of vehicle fuel economy on the required label. Importantly, MPG figures are derived from window sticker figures, which are 28% lower than CAFE figures.

Table 1. Feature values for six different wanys to convey fuel efficiency data in a sample survey.

Table 1: **Feature values for six different ways to convey fuel efficiency data in a sample survey**

Characteristics and stages		Little vehicle	Medium Vehicle	Big vehicle	Little SUV	Medium SUV	Big SUV	Microbus	Utility vehicle
State 1: Fuel efficiency of town/highway (MPG)		30	30	25	25	30	22	32	28
		36	32	30	30	32	28	35	32
		45	40	35	35	43	35	38	39
		50	45	45	42	47	38	42	49
State 2: Yearly price of gasoline ($)		1550	1870	2000	1880	2250	2500	2470	3500
		1180	1350	1780	1670	2040	2175	1800	3110
		1100	1110	1480	1420	1870	1860	1690	2150
		980	985	1210	1195	1480	1690	1550	1950
State 3: Six years of fuel price ($)		7110	8115	10105	9850	11200	12500	11180	13200
		6825	7840	9570	8955	10130	11689	10986	12400
		5190	6550	8715	8120	9876	1042	10100	11200
		4950	5570	7500	7950	8955	975	940	10655
State 4: Spending and saving vehicle average over 6 years ($)	Save	750	700	980	820	1040	1120	990	1250
		1300	1450	1800	1865	1998	2650	2100	2750
	Spent	1600	1850	1950	2050	2500	2950	2710	2840
		300	420	550	410	570	550	670	800
State 5: Annual gasoline prices ($)		18250	20500	25750	22780	28950	30580	28740	30750
		15625	18750	20950	18765	25750	28750	25985	26795
		13350	15680	18600	17658	24500	25980	22744	24985
		10200	12700	15790	14780	20788	22750	20500	22355
State 6: Entire fuel economy (MPG)		35	32	32	25	25	22	25	20
		28	30	28	28	20	18	15	25
		50	28	24	32	35	15	32	27
		45	34	30	39	38	28	30	35

Participants were informed that 60% of fuel expenditures and fuel economy estimates depended on the city, 40% on the highway driving rate, and fuel prices depended on 16,000 miles per year at $3.5 per gallon. Annual mileage for 2020 model-year cars and EPA gas prices are used to calculate these statistics. Participants can use their existing and predicted travel plans while picking, however, the research tries to highlight that the selection test petrol prices depend on this assumption. The lifetime fuel price state participant stated that fuel prices were computed at $4.00 per gallon based on 160,200 miles over 30 years. This price increase depends on the EIA's long-term predicted gas price increases. Vehicle characteristics and conditions were developed via customer report interviews with automotive professionals. All participants acknowledged the challenge. The performance design distributed all possible combinations of these characteristics and levels between optional packages. The D-effectiveness was 94 percent, which was higher than the conventional recommendation of 85 percent and suggests a "better" symmetrical and orthogonal design. The best acceleration and fuel economy cannot be coupled, nor can the two and three levels of extraordinary features and trims with the lowest price. These controls were intended to avoid unrealistic attribute combinations during design. The final 50 exam packets had eight blocks with six choices, and participants were assigned to finish one block. The study tested all feature combinations' dependability and realism with 230 target audience members in a pilot release.

Random assessment for conditions related to fuel economy

In the conducted choice experiment, participants were randomly allocated to different conditions, with each condition providing fuel efficiency statistics in different forms. The purpose of these circumstances, referred to as States 1 through 6, was to evaluate how participants' perceptions and decisions about fuel efficiency were impacted by the way information was presented. State 1 provided fuel efficiency information in the form of miles per gallon (MPG), which accounted for both city and highway driving circumstances (e.g., "25 MPG"). The fundamental parameter for comparison in State 2 is the yearly fuel cost, omitting annual miles. State 3 presented data on the total gasoline expenses over a period of six years, which amounts to $9,150. This calculation is based on an estimated mileage of 80,000 miles during a period of five years. Present four specific fuel efficiency statistics as prospective savings or expenses over a six-year duration as compared to a typical new automobile in the same category (e.g., "Save $500 on fuel expenses over six years"). State 5 implemented the notion of lifetime fuel expenses, derived from the Car Miles Travel Plan for Passenger Vehicles by the National Highway Traffic Safety Administration. This state evaluated the mileage of a car over a span of 30 years, assuming an average of 160,150 miles per vehicle, and took into account an expected rise in petrol prices to $4 per gallon (e.g., "$20.80"). State 6 provided participants with a detailed EPA fuel economy label that included information on MPG, yearly fuel cost, the participant's vehicle class, fuel economy, greenhouse gas emissions estimates, and possible savings or expenses over a six-year period compared to a regular new car. The labeling also had a smoke rating, which was uniformly set at 5/10 for all vehicles. The researchers used several experimental setups to clarify the impact of different ways of presenting fuel economy data, such as simple MPG statistics or extensive EPA labeling, on participants' perceptions and decision-making processes when it comes to fuel-efficient automobiles.

These six study settings were chosen precisely to evaluate whether the type of fuel efficiency presentation causes participants to value fuel economy the most. Recall that states 1, 2, and 4 were chosen to describe distinct elements of the whole EPA fuel economy labeling (excluding greenhouse gas and smog rating), and the study investigates whether any of these elements of the label appear to be more significant than others. State 3 and State 5 are included in the research because the study believes that greater fuel price numbers (as opposed to fuel utilization numbers) may be more persuasive in influencing people to make fuel-effectiveness decisions than the elements on the entire fuel economy label. Because participants may utilize the data that was most pertinent to them or was most recognizable to them, State 6 was chosen to examine if the entire EPA fuel economy labeling (incorporating States 1, 2, and 4) could result in a higher fuel economy assessment.

3.3. Rationale of the study

The selection of Ghana as the study context stems from various considerations.

Firstly, Ghana represents a developing economy within the African continent, characterized by unique socio-economic and cultural factors that could influence consumer behavior and preferences in the automotive market. By choosing Ghana, researchers aim to explore how factors such as income levels, infrastructure development, and cultural norms impact individuals' intentions to purchase or lease cars over the next twelve years. Moreover, Ghana's automotive market presents distinct challenges and opportunities compared to more developed regions, making it an interesting case study for understanding consumer attitudes toward vehicle preferences and fuel economy. Factors such as urbanization rates, environmental concerns, and government policies related to transportation and emissions significantly shape individuals' decisions regarding vehicle selection and fuel efficiency preferences.

3.4. Potential limitations

However, it's essential to acknowledge potential limitations or boundary conditions related to the generalizability of findings from Ghana to other contexts.

Firstly, Ghana's specific socio-economic and cultural context may limit the transferability of results to countries with different demographic profiles or economic structures. Additionally, factors such as government regulations, fuel prices, and infrastructure development in Ghana may differ significantly from other regions, affecting the applicability of research findings to diverse settings.

Furthermore, the sample size and composition of the study participants could influence the generalizability of the results. For instance, if the survey primarily targeted individuals from specific regions or socio-economic backgrounds within Ghana, the findings may not accurately represent the diversity of consumer preferences across the entire population or in other countries.

While Ghana provides a valuable context for exploring consumer attitudes toward vehicle preferences and fuel economy, researchers should carefully consider the contextual factors and potential limitations to ensure the appropriate interpretation and generalizability of their findings.

3.5. Evaluation of data

This study analyzes the first research objective (measuring how fuel economy data affects customer judgment) by examining test participants' vehicle replacement selection at each test stage. Excellent median fuel efficiency quality scores show more frequently picked cars with higher fuel efficiency throughout the test. The study determined each participant's average ranking in six selection packages representing the lowest, central, and most effective vehicles from "1," "2," and "3." At each test level, Kruskal Wallis H finds potentially significant vehicle performance changes. We can determine fuel efficiency data to examine if participants' preferences for fuel-efficient cars changed. Since the Kruskal-Wallis (non-parameter) H-test improves ranking criteria, the study uses it. The paper analyzes three MNL models with STATA 16.1. Models assess fuel efficiency overall and by vehicle and population in each test scenario. These models construct utility coefficients for each feature to determine participants' car quality preferences. Alternative: the model-dependent variable determines preferences for each aspect while keeping other characteristics and independent elements. The probe removes alternative-specific constants since alternatives fluctuate and are unlabeled. The study shows how participants value fuel efficiency over car cost using WTP values. The Delta method calculates WTP standard errors. To compare fuel efficiency, all MNL models use fuel cost per year. This study examined fuel-efficiency models using MPG and gallon/1020 miles, as well as annual nonlinear increases in fuel cost, MPG, and gallons. Except for the lifetime fuel price scenario, the study used $4/gallon, MPG, yearly automobile kilometers, and $3.78/gallon gasoline. The study contrasted computation methods. The study indicates that participants may have perceived the instructions differently, a selection procedure issue. 50% of trial participants drove between states at $3.78 per gallon, the average for this car. In the choice experiment (for matched circumstances), estimated yearly kilometers, gasoline cost, and city/highway driving proportion were utilized to calculate fuel cost. This argument may also indicate that individuals assume past, current, and future driving behaviors and fuel prices. The study included participants' claimed mileage when computing annual fuel expenses because they presumably behaved as expected. The study computed fuel cost annually using 16,000 automobile miles driven to test the assumption, but it did not affect model conclusions in relevance, sign, or number of variables. The fuel economy criterion was $4.00 per gallon to simulate escalating gas prices over the vehicle's lifetime. The study calculates annual gasoline costs from participant input using this number. The study examined using $3.85/gallon gasoline instead of $4.00/gallon to calculate the lifelong fuel cost each year, but the results were unaffected.

4. Results and discussion

4.1. Data collection

A market research organization assembled a cross-national sample of Ghana automobile buyers (age 20 or older) with a valid driver's license who plan to lease/buy a used or new car in the next twelve years. All participants planned to lease or buy a car within 12 years, while 65% planned to do so within two years. The final database includes 950 vehicle buyers or tenants, excluding 250 who failed three quality assurance queries based on Ghanaians' age, gender, education, race, income, and geographical area. Finish the study in under half the average time (n = 195). The study cannot identify whether this sample of targeted car buyers or lessees is representative due to a lack of demographic data. Previous research has shown that those planning to buy a new car are older, more educated, and have higher family incomes.

4.2. Analytics' effects on vehicle choices

Utilizing the factor of ranking car selection, the research first examines whether the six fuel economy data performance types have a distinct effect on purchaser car selections. The total significant variation between the condition averages was found using the Kruskal-Wallis H test, $\chi^2(5) = 70.25$, $p < 0.001$. In particular, persons who were shown MPG data chose vehicles that were considered most fuel-efficient (M = 3.35) than those that were shown the yearly cost of fuel (M = 3.40, average rating = 910.10), five-year cost of fuel (M = 3.30, average rating = 950.85), and spend/save comparability (M = 3.26, average rating = 952.35). Related to this, people who participated chose meaningfully more fuel-efficient cars when the entire fuel economy labeling was displayed (M = 3.57), as opposed to when the yearly cost of fuel, five-year cost of fuel, or spend/save evaluation were displayed (M = 3.21), five-year cost of fuel, or M = 3.13, respectively.

4.3. Evaluating fuel economy

To better assess intervention effects, the study produces three MNL techniques using participation options and experimental values from the six test conditions. Remember that each option set's vehicle selection is the model's predictor variable. The three models' automobile feature coefficients are important (98%) and predict the direction. Participants preferred cars with lower initial prices, running costs (or fuel efficiency), and acceleration. Participants preferred cars with higher safety, dependability, luxury amenities, and finish. Participants value fuel efficiency, as seen by the high, maximum fuel economy levels (annual fuel price).

Each factor in modeling 1, 2, and 3 and its relationship to the annual gasoline price will be discussed next. Participants should know that the non-interacted cost of fuel annually coefficient and the interacted coefficients "summarize" the interacting variables. Model 1 analyzes every situation using the annual gasoline cost. Since this is how customers usually get fuel economy data, the non-interacted fuel price yearly coefficient is the "basis" for comparability and reflects state 6 (full EPA fuel efficiency label). Model 1 reveals that participants value gasoline savings. Tests 2–5 participants underestimate fuel savings compared to the baseline 6. State 1 and State 6 have similar values. The biggest benefit of fuel economy is that state 6 residents will spend $20.52 to save $1/year on petrol. State 1 drivers can save $1 a year on gas to a comparable, rarely altered WTP value of $18.52.

People in state 4 were willing to spend $6.5 despite having a poorer fuel efficiency rating than the median automobile in their vehicle class (fuel economy should be spent or saved for more than five years). Fuel prices should drop $1 yearly. WTP value comparisons across study contexts are more interesting than integers. Based on the strong critical coefficient for the annual petrol price situation, state 6 has a substantially superior fuel economy estimate than states 2, 3, 4, and 5 (excluding state 1). **Figure 4** compares Model 1 WTP rates and shows an additional method for assessing scenario differences. 95% of non-aligned trust gaps affect WTP rates significantly. Standard errors of WTP values calculated using the delta technique provide effects slightly different from Model 1 when standard errors from various coefficients are combined. **Figure 4** gives a reasonable view of the significant mode differences. **Figure 4** shows that state 6 residents prioritize fuel economy over states 2, 3, and 4. In addition, state 1 prioritizes fuel efficiency over state 4. Thus, in some situations, the study may find that fuel economy data presentation greatly affects participant perception.

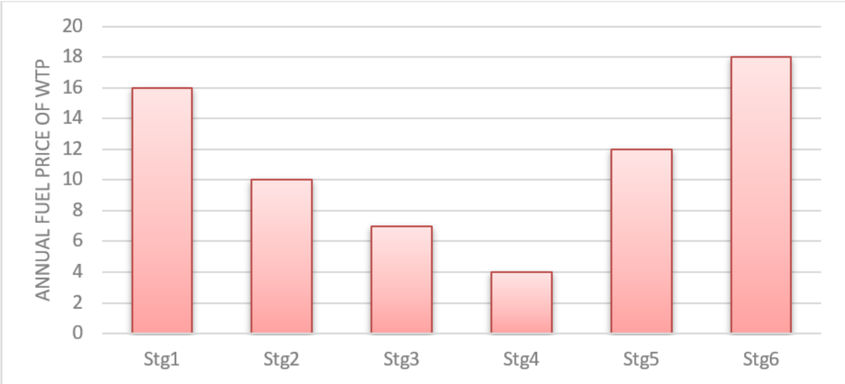

Figure 4. Various state fuel price estimation.

Model 2 of the study integrates participants' demographic data and car preferences with fuel efficiency. The results indicate that the fuel efficiency rating is correlated with the age of the participants and the anticipated cost of their future vehicle, while not being influenced by any other characteristics. The primary WTP (Willingness to Pay) value for this model is $10.25, resulting in an annual fuel cost savings of $1. Each subsequent year is linked to a $0.20 increase in saving $1 each year on fuel costs, indicating a robust and efficient correlation between age and fuel efficiency. Consequently, a participant who is 60 years old would be inclined to expend $18.95 to evade an annual payment of $1 for gasoline. For every increase of $1500 in the projected purchasing cost, participants are willing to reduce their expenditure by $0.30 to save $1 annually on fuel prices. Conversely, the anticipated expense of buying into the program is significantly and inversely correlated with the fuel efficiency rating of the subsequent vehicle. Consequently, an individual intending to allocate $40,000 towards their next vehicle would be willing to spend $3.98 to save $1 annually on fuel expenses. The study pertains to participant demographics, preferred car attributes, and the state of the Model 3. The Model 3 provides a significant estimate of fuel efficiency throughout states 2-6, in addition to considering the age of the participants' future automobile and the projected purchase price. Table 2 displays the willingness to pay (WTP) values for various scenarios and the anticipated impact on the purchase price of a vehicle, specifically for a typical 60-year-old individual with a projected automobile cost of $30,000. **Figures 5** and **6** depict the correlation between age and WTP ratings, as well as the anticipated cost of a new vehicle in different scenarios. To enhance the readability of the graphics, the study omits confidence intervals. This is because, when calculated using the Delta technique and combining standard error values, many confidence intervals would overlap. When accounting for participants' ages and projected future car purchase expenses, this model demonstrates significant discrepancies across different situations. **Figures 5** and **6** illustrate the disparity in willingness to pay (WTP) based on age and the projected cost of the next car, together with an approximate estimation derived from the condition. The willingness to pay (WTP) values of participants aged 80 years range from $12.97 (state 4) to $25.35 (state 6), whereas the WTP values of persons aged 18 years range from $6.75 (state 4) to $18.95 (state 6). Participants aiming for the lowest expenditure ($0) on their prospective vehicle are willing to pay any amount ranging from $3.55 (denoted as state 4) to $15.91 to save $1 per year on fuel. The individuals residing in state 6, particularly senior citizens and those interested in purchasing more affordable vehicles, demonstrate the highest willingness to pay rates for saving $1 per year on gasoline expenses. These rates align with the patterns observed in Models 1 and 2. Furthermore, the study focuses primarily on the relative assessment conveyed by WTP values rather than their absolute levels.

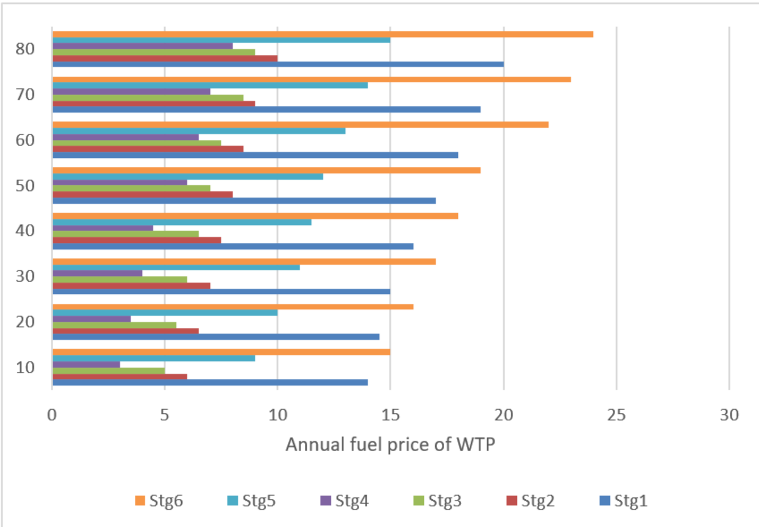

Figure 5.

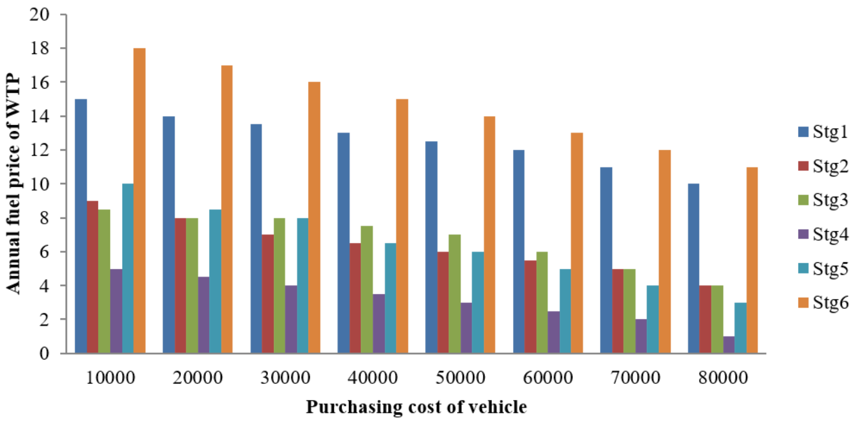

Figure 6. Annual fuel cost based on purchasing a new vehicle.

Buyers' fuel economy valuation research expands with this study. The study employs a specific selection experiment and random, comparable conditions to determine how fuel economy data display influences fuel economy estimation. We wanted to know how data presentation affects consumers' fuel economy values. According to this study, which randomly assigned participants to the treated group, different conceptualizations of fuel economy can influence participants a selection of fuel-efficient cars and how much they are willing to pay for annual fuel price savings. Indirect WTPs include yearly gasoline cost ($10.52), five years of fuel price ($9.00), and six-year fuel savings/spending compared to a car. Then that class ($7.30) was considerably better than the implicit WTP for fuel economy under the complete EPA-mandated label ($20.52 to save $1/year on fuel). EPA labeling WTP ratings were similar to MPG ($20.45) fuel economy figures. Fuel economy labeling display may have created the largest WTP since it offered so many activities that appealed to different people. This broad-spectrum label from EPA helps readers focus on the most critical attributes. Environmental sustainability enthusiasts can view CO_2 emissions data, and finance enthusiasts can view annual or six-year gasoline price data. Another hypothesis is that multiple metrics persuade people better than one. The results suggest that fuel economy may be more valuable with more data, which builds on prior research that informed the revamp of the required fuel economy label and that examined how certain EPA fuel economy label components affect purchase decisions. The values of WTP for those who have seen the total fuel economy labeling are much higher than two of the three mechanisms, especially the total fuel price and the quantity saved/spent on fuel over six years, indicating that an average vehicle in that class may have ratings added to the values. WTP, whose value and ownership were only claimed under the MPG scenario, did not differ much from absolute fuel economy labeling, which is intriguing. MPG, Ghana's most frequent fuel efficiency indicator, is easy to study, thus many customers may focus on it. For effective car buying, clients most often cite financial and savings aspirations. MPG appears to save the most gasoline according to the full EPA labeling.

Reliability and familiarity are another reason why those who saw the EPA fuel efficiency label gave fuel economy statistics the highest scores. Since the data was presented as a real label rather than just "25 MPG" with the other features, people were more attentive to it. Thus, while fuel efficiency data appeared the same under other settings, the specified test seemed distinct from other attributes. Participants may have been more interested in fuel efficiency when the entire EPA label is visible.

Based on customer information and vehicle attributes, the study indicated that age considerably and favorably affects fuel economy (WTP is $0.20 older each year to save $1 per year on fuel expenditures). A Ghana automobile sales survey found that fuel economy is higher for the elderly. Significantly, the study demonstrated a negative association between the participant's next automobile and the predicted fuel economy purchasing price (WTP - $0.30 to $1500 price increase to save $1/year).

This study shows that WTP values vary in fuel efficiency evaluation, with some overvaluing and others underestimating. The "rational actor" will value a $1/year fuel cost decrease at $15.96 at a 7% discount and a 30-year vehicle lifespan. Participant WTP calculations in the whole EPA labeling ($19.55) and MPG ($17.45) cases show overvaluation with discount rates of 3–4%. However, participants in the lifetime fuel cost scenario have a WTP value of $12.52, indicating almost the full evaluation and an anticipated 8% discounted rate. Importantly, the WTP calculation for a person with a median age (60), expected car cost ($30,000), and near-full fuel efficiency, with an assumed discounting rate of 6%–7%, reveals near-full fuel economy evaluation. Fuel economy savings may be undervalued because other WTP estimates have discounted rates of 15–18%.

4.4. Implication of polices

Understanding how customers value fuel economy is essential to creating a successful policy. Fuel efficiency requirements' effects on the vehicle market and the economy can be predicted by understanding how purchasers value speed and fuel economy. In the same manner, knowing how to convey fuel economy statistics to get buyers to act on their interest in this feature is vital since consumers' stated preferences don't necessarily match their actual buying behavior.

Fuel-efficient vehicles cut transportation emissions if politicians encourage their purchase. These findings imply that the mandatory fuel economy label may be the most effective promotional tool for fuel-efficient cars and the most accurate fuel economy assessment. There is little data on how real-world purchasers use the fuel efficiency mark. A fuel economy plan could compel or encourage providers to promote fuel efficiency when customers make decisions.

Despite fuel economy labeling encouraging purchasers to pay the most, spending "just the right amount" may be more significant. The study overestimated WTP rates yet evaluated some scenarios nearly completely. Improving fuel economy perception may support most fuel efficiency choices, but governments may need to evaluate distribution techniques to encourage "sensible" purchasing decisions. The data that teaches fuel economy estimation is like net profit.

WTP disparities for gasoline price decreases in different data refute the hypothesis that buyers behave logically. Consumer preferences may not be enough to move markets toward desirable goals, thus regulation is needed. Irrational discovery may explain why people demand big, fuel-inefficient autos. Automakers can raise demand by appealing to consumers' vehicle symbolism. SUV advertising shows outdoor activities and areas where you can do whatever you want, even though most SUV drivers stay on sidewalks and don't off-road.

4.5. Practical implications

The findings of the study have several practical implications for policymakers and automakers. Firstly, policymakers can use the insights gained from the study to develop targeted interventions aimed at promoting fuel efficiency and reducing transportation emissions. By understanding how consumers value fuel economy and respond to different types of fuel economy information, policymakers can design policies that incentivize the purchase of fuel-efficient vehicles.

One specific strategy that policymakers could consider is the implementation of mandatory fuel economy labeling for vehicles. The study suggests that such labeling may be the most effective promotional tool for fuel-efficient cars and can lead to more accurate assessments of fuel economy by consumers. By mandating the inclusion of fuel economy information on vehicle labels, policymakers can ensure that consumers have access to relevant information when making purchasing decisions.

Additionally, the study highlights the importance of improving consumer perception of fuel economy and the value of spending. While fuel economy labeling may encourage consumers to prioritize fuel efficiency, it is essential to ensure that consumers make “sensible” purchasing decisions that align with their actual needs and preferences. Policymakers may need to evaluate distribution techniques to promote rational decision-making and encourage the adoption of fuel-efficient vehicles.

For automakers, the findings suggest opportunities for marketing strategies that appeal to consumer preferences and perceptions. By understanding consumer attitudes toward fuel efficiency and vehicle symbolism, automakers can tailor their marketing efforts to emphasize the benefits of fuel-efficient vehicles. For example, advertising campaigns that highlight the practical advantages of fuel efficiency, such as cost savings and environmental impact, may resonate with consumers and encourage them to choose fuel-efficient options.

The study underscores the importance of considering consumer behavior and preferences in shaping policies and strategies aimed at promoting fuel efficiency and reducing transportation emissions. By leveraging insights from studies such as this, policymakers and automakers can develop more effective interventions that address the challenges of sustainable transportation and contribute to positive environmental outcomes.

5. Conclusion

The study highlights a crucial discovery: the way fuel efficiency information is presented has a major impact on customers’ views of its worth. The data indicates that using a wider variety of measures leads to the greatest level of willingness to pay (WTP) for fuel efficiency. These findings explain the discrepancies in customer judgments of fuel efficiency, suggesting that one factor contributing to these inequalities is the variation in measuring methodologies employed by researchers. Furthermore, the study emphasizes the important influence of providing consumers with fuel economy information on their car selections. Significantly, the results highlight the wide range of fuel economy evaluations reported among national representatives. They emphasize that although buyers prefer fuel efficiency, not all indicators hold the same level of importance. Thus, utilizing a diverse range of data can enhance the evaluation of fuel efficiency. The study suggests that future research should further investigate the most effective approaches for providing fuel efficiency information to customers. In addition, it proposes investigating the threshold at which assessments start to decrease as a result of issues such as an excessive quantity of indications, an overwhelming amount of labels, or the cognitive exertion demanded from consumers. This study provides useful insights into the intricacies of consumer decision-making in the field of fuel economy by examining the impact of age on customer preferences, as well as the influence of different vehicle qualities and situations.

Author contributions: Conceptualization, GOM; methodology, GOM; software, GOM; validation, GOM; GOM and DY; formal analysis, GOM; investigation, GOM; resources, GOM and DY; data curation, GOM; writing—original draft preparation, GOM; writing—review and editing, GOM and DY; visualization, GOM; supervision,

DY; project administration, DY; funding acquisition, DY. All authors have read and agreed to the published version of the manuscript.

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